# ENERGEX MINERALS LTD.
# TOODOGGONE PROJECT

# A PRELIMINARY EVALUATION OF HEAP LEACHING JULY 1986

KILBORN

This project was jointly funded by Energex Minerals Ltd. and the Canada/ British Columbia Mineral Development Agreement (1985-1990), a joint Federal/Provincial agreement intended to stimulate and diversify the mining industry in British Columbia.

# ENERGEX MINERALS LTD.

# TOODOGGONE PROPERTY

# A PRELIMINARY EVALUATION OF HEAP LEACHING

SUBMITTED BY:

KILBORN ENGINEERING (B. C.) LTD.
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JULY 1986

# ENERGEX MINERALS LTD.

## TOODOGGONE PROPERTY

## A PRELIMINARY EVALUATION OF HEAP LEACHING

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# 1.0 INTRODUCTION

# 1.0 INTRODUCTION

Energex Minerals Ltd. (Energex) holds a 100 percent interest in 565 contiguous claim units, known collectively as the Toodoggone Project. The claims are approximately 300 kilometres north of Smithers, British Columbia. Access to the Property is by air using the Sturdee airstrip from which a 24-kilometre road leads to the Baker Mine and Lawyers properties. A cat trail is used to reach Energex' properties from the end of this road.

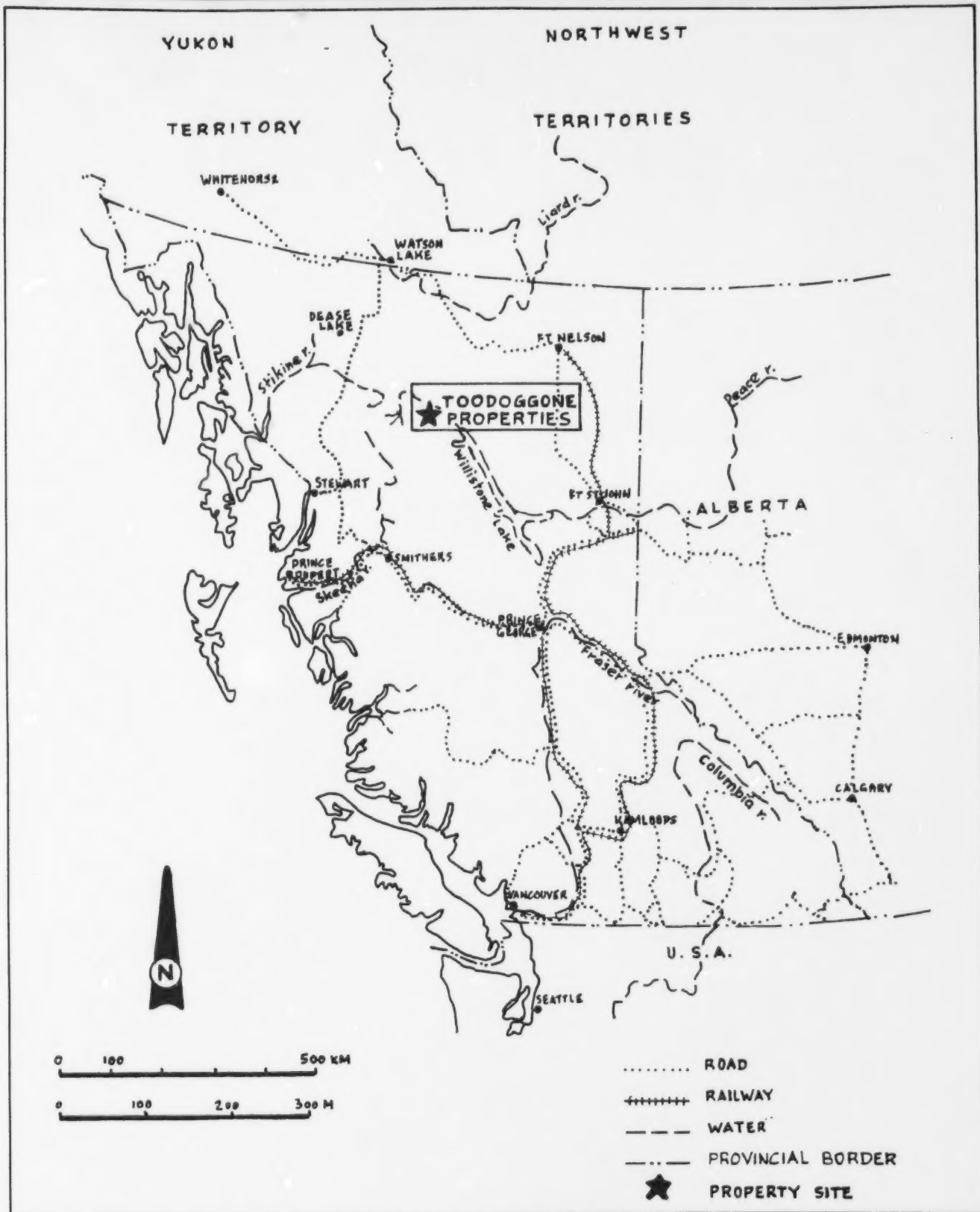
The claims are located 1,200 to 1,900 metres above sea level; temperatures range from minus 40 degrees Celsius to plus 30 degrees Celsius. The total annual precipitation is reported to be approximately 1.0 metre.

The Toodoggone Project claims owned by Energex have been divided into 3 principal areas: the AL, JD and Moose Prospects.

Precious metal values of significance have been found as a result of the Company's intensive exploration programs in the area. In particular, the Thesis III Zone of the AL claim group offers the potential to support an economically-viable open-pit mining operation.

Energex commissioned Kilborn Engineering (B. C.) Ltd. (Kilborn) to investigate the feasibility of heap leaching 30,000 tonnes of this material. Kilborn was requested to determine the range of gold prices and feed grades which would be required to generate a positive cash flow. Through the adoption of standard grade control procedures and the stockpiling of low grade material, it is reported that grade of the heaps could be within the range 0.10 - 0.25 ounces of gold per ton of ore.

The mine production and cost data used throughout this Study were prepared by Arthur T. Fisher & Associates Ltd.




| | | |
|---|---|---|
| TITLE: LOCATION MAP – TOODOGGONE PROPERTIES | SECTION: MINING | |
| KILBORN ENGINEERING (B.C.) LTD. | AREA NO: | REV. NO: |
| CLIENT: ENERGEX MINERALS LTD. PROJECT NO: 7845-15 | DRAWING NO: FIG. 1.0-1 | |
| APPROVED: DATE: JULY 18, 1986 | | |

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# 2.0 SUMMARY

## 2.0 SUMMARY

A preliminary evaluation of the economics of operating a 30,000 tonne gold ore heap leach in the Toodoggone area has been made.

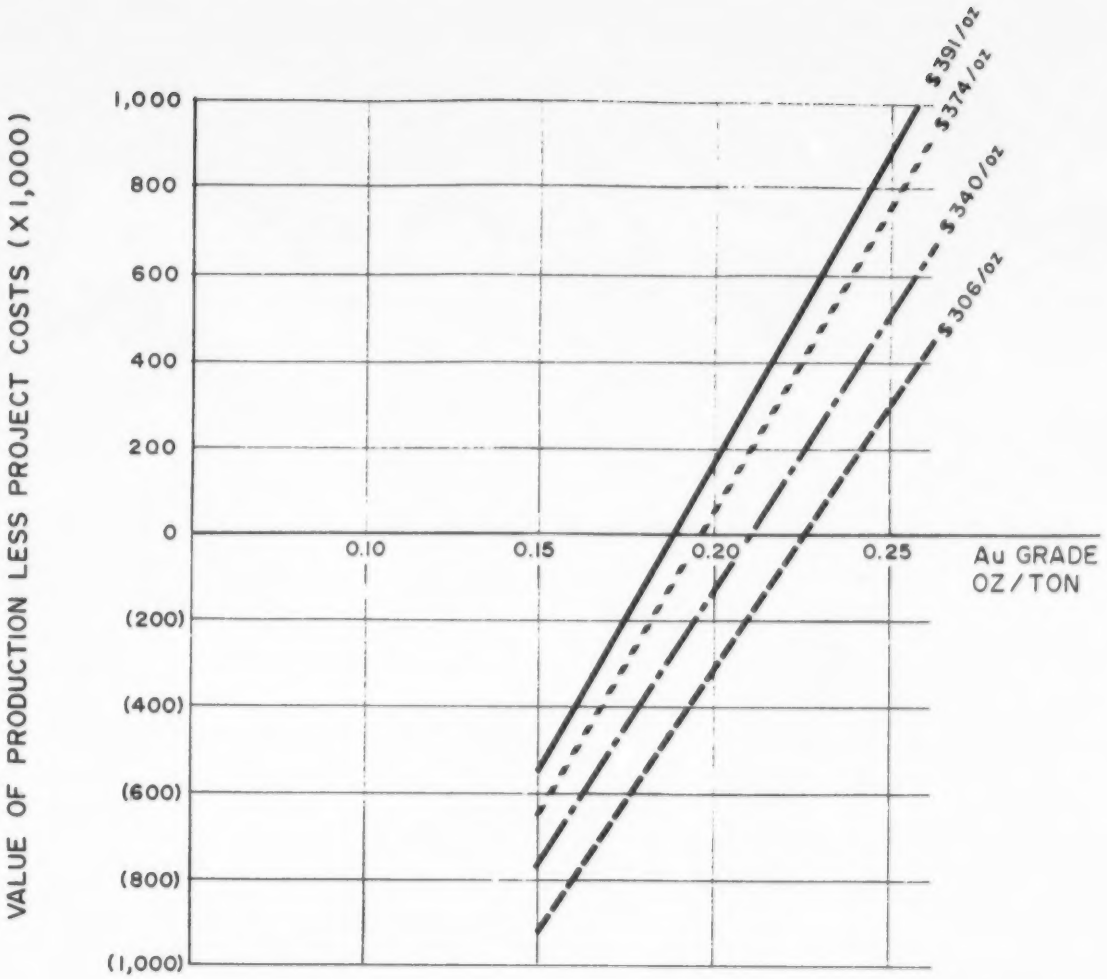
The Project cost has been estimated to be as follows:

| | Cost $ Canadian |
|---|---|
| Mining | 750,000 |
| Processing | 1,231,000 |
| Power Supply | 20,000 |
| General and Administration | 75,000 |
| TOTAL | 2,076,000 |

At current gold prices of (U.S.) $345 per troy ounce, a positive cash flow will be generated by the treatment of ore grading in excess of 0.21 ounces of gold per ton. This is based on a treatment period of 3 months resulting in an overall recovery of gold of 69 percent. Any extension to the season and additional recovery in subsequent seasons will enhance these economics.

Some laboratory column leach test work should be conducted prior to committing to the 30,000 tonne Project.

The mobile equipment and process plant will be leased for the periods required.




PRODUCTION

| GRADE OZ/TON | GRAMS/TONNE | TOTAL OZS | TOTAL RECOVERY % |
|---|---|---|---|
| 0.25 | 8.57 | 5425 | 72.3 |
| 0.20 | 6.86 | 4120 | 68.7 |
| 0.15 | 5.14 | 2730 | 60.7 |

| | | |
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| TITLE: GROSS PROFIT VERSUS GOLD GRADE | SECTION: MINING | |
| KILBORN ENGINEERING (B.C.) LTD. | AREA NO: | REV. NO |
| CLIENT: ENERGEX MINERALS LTD. PROJECT NO: 7845-15 | DRAWING NO: FIG. 2.1 | |
| APPROVED: DATE: 18 JULY, 1986 | | |

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# 3.0 PROCESS DESCRIPTION

# 3.0 PROCESS DESCRIPTION

## 3.1 GENERAL

Run-of-mine ore, crushed to a nominal 19 millimetre size, will be leached on one of three, 10,000 tonne heaps. Gold will be extracted from the pregnant solution using carbon adsorption techniques. Loaded carbon will be stripped and the gold extracted electrolytically from solution. The gold impregnated steel wool cathodes will be smelted to produce bars of bullion.

No metallurgical test work has been performed to date for the heap leach process. The circuit proposed is in common use, however, and based upon well proven technology.

The sizing and configuration of process equipment have been selected in accordance with the design criteria described in Section 3.6 of this Study. Since considerable flexibility exists in the design of such plants, modifications will be made as required during more detailed engineering to accommodate crushing and gold extraction plants which are available on a lease basis.

## 3.2 SITE PREPARATION

### 3.2.1 Leach Pad Construction

Three leach pads will be constructed, each 50 metres by 50 metres.

Three individual leach pad areas are proposed for the heap leaching of the 6.1 metre high heaps of minus 19 millimetres crushed ore, each being approximately 50 metres by 50 metres.

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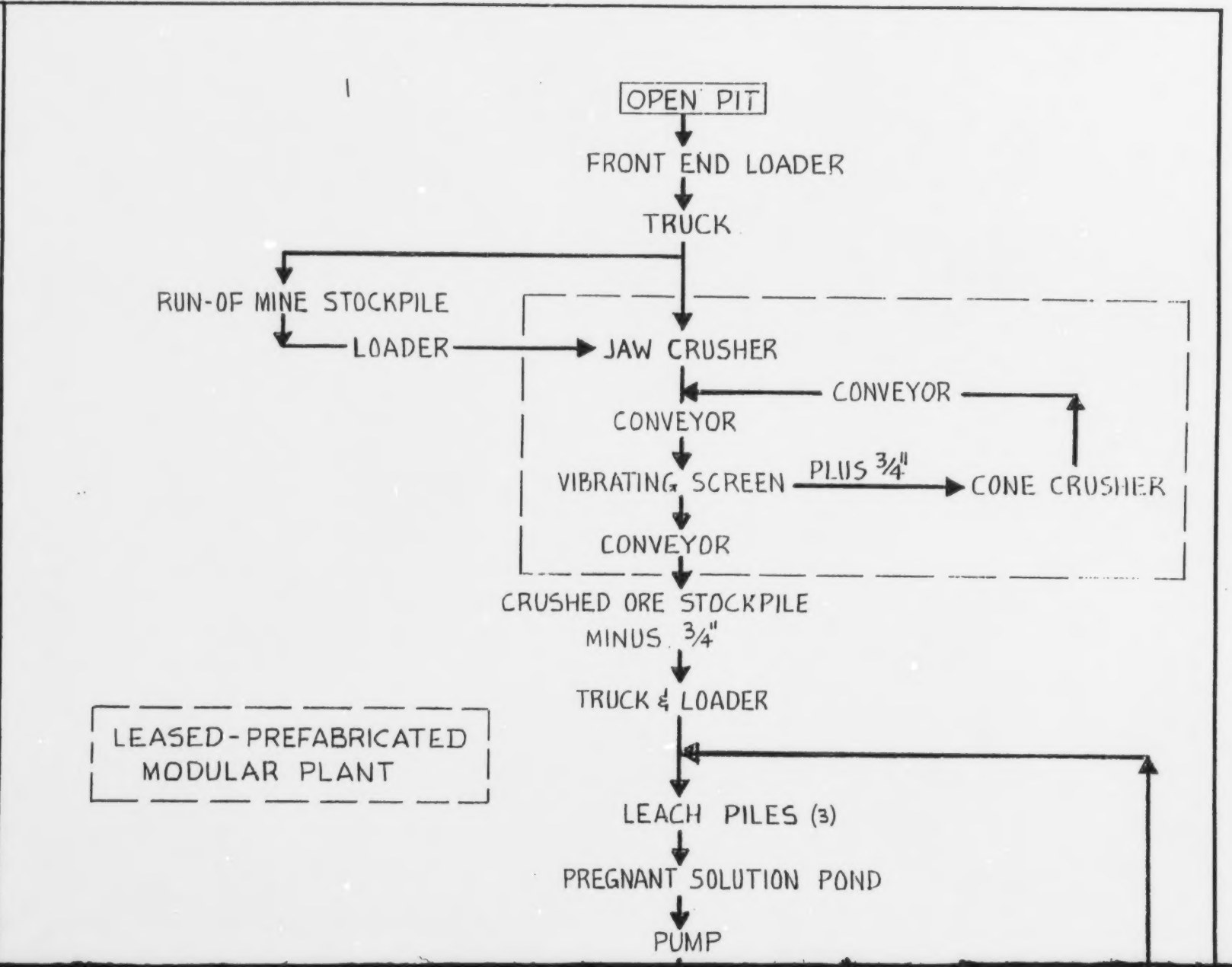


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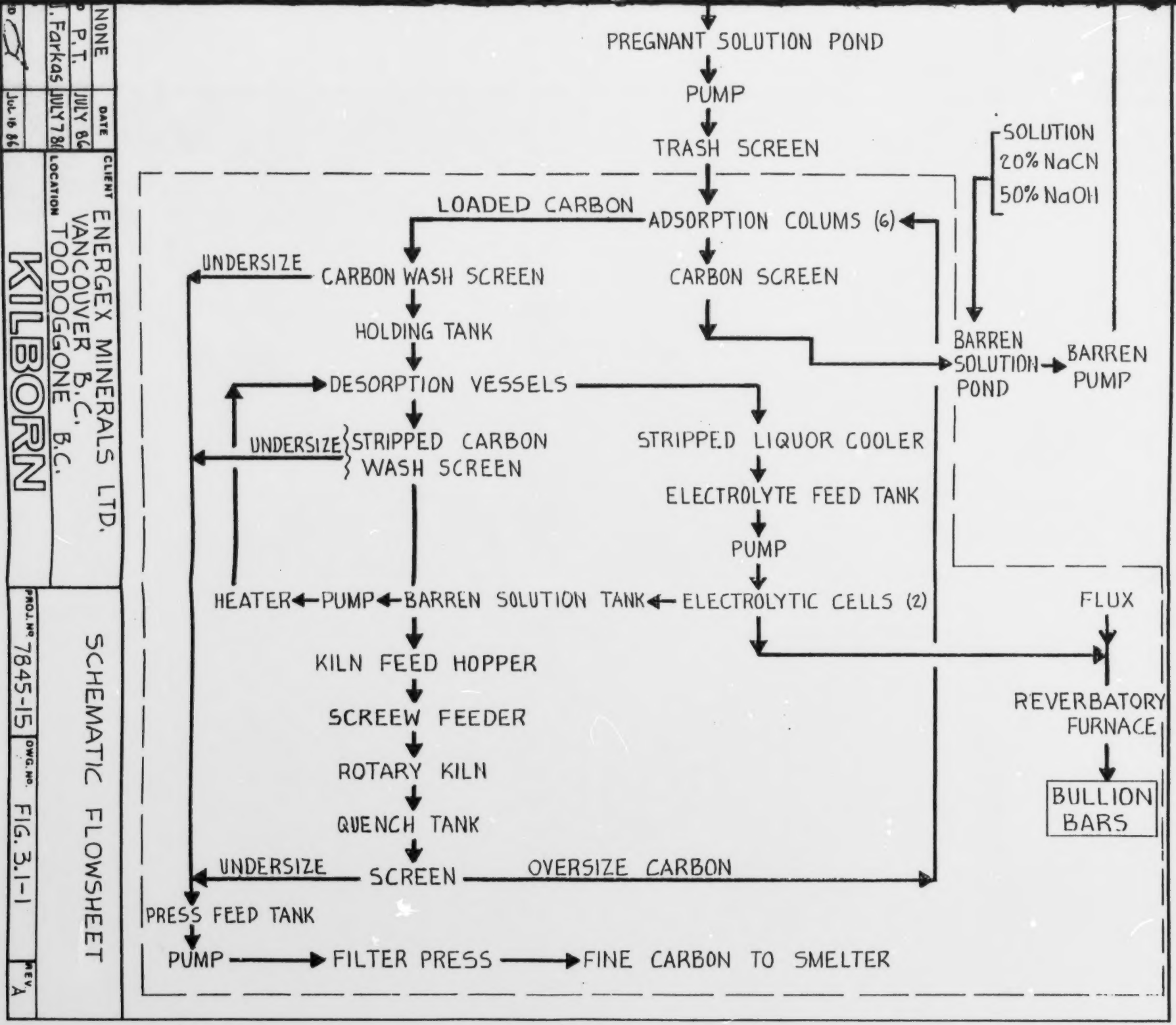


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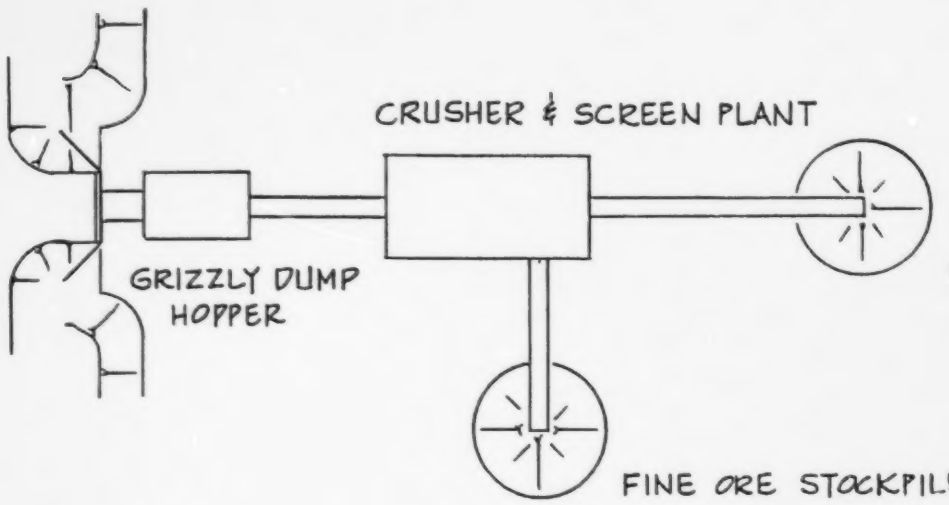
| P.T. | J. Farkas | | Jul 16 86 |
| JULY 86 | JULY 7 86 | | |
| DATE | | | |

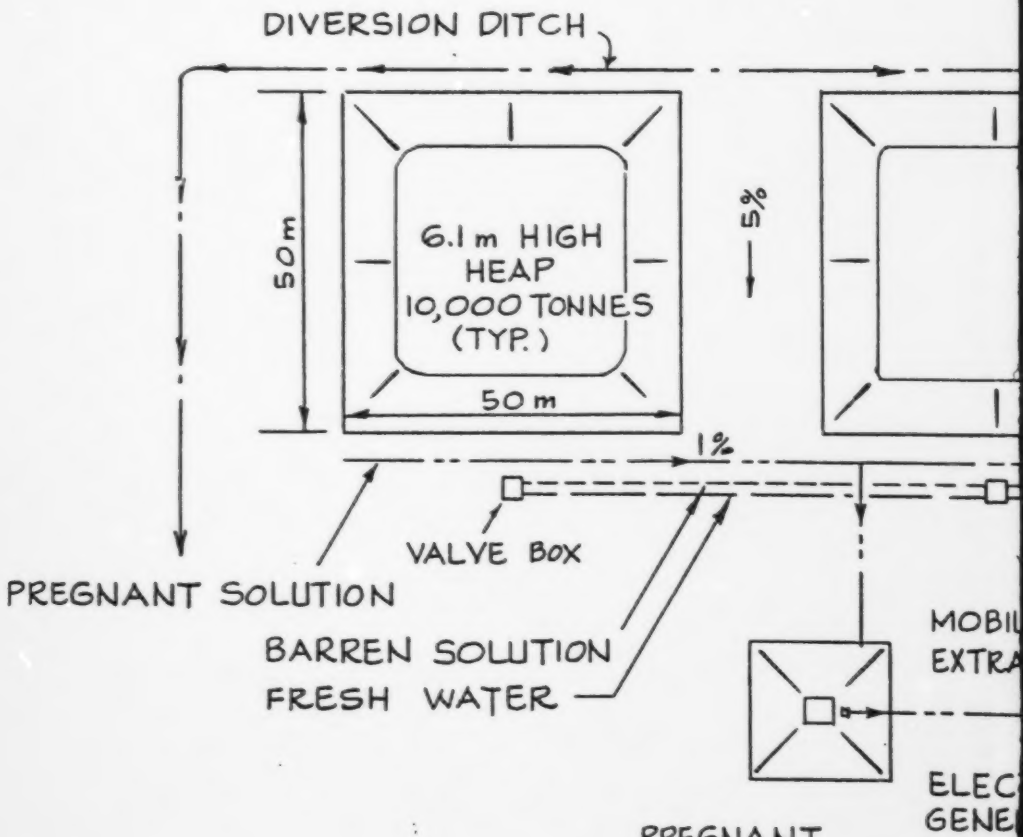
CLIENT: ENERGEX MINERALS LTD.
LOCATION: VANCOUVER B.C. TOODOGGONE B.C.

KILBORN

PROJ. NO 7845-15 | DWG. NO. FIG. 3.1-1 | REV. A

SCHEMATIC FLOWSHEET

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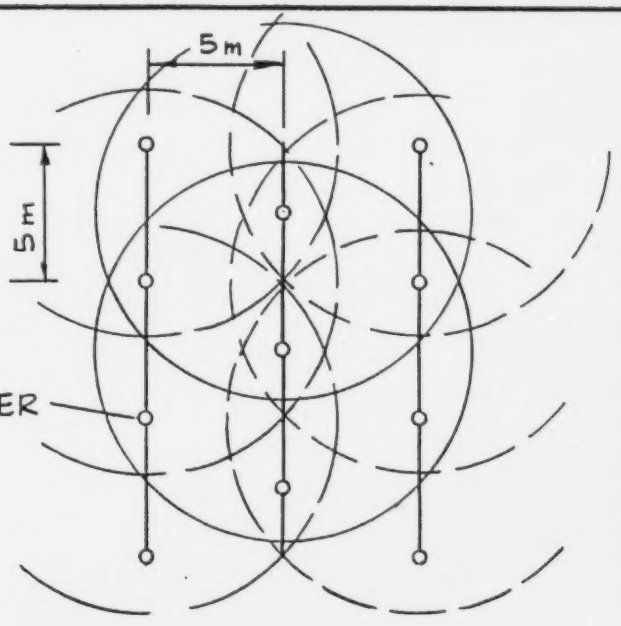



SOLUTION SPRAY PATTERN

OVERSIZE ORE STOCKPILE

SENNINGER # 12 WOBBLER (TYP.)

5%

1%

REAGENT STORAGE

MOBILE GOLD EXTRACTION PLANT

ELECTRIC GENERATOR

BARREN SOLUTION POND
20m x 20m x 5m DEEP

FRESH WATER POND
30m x 20m x 5m DEEP

| ITS | DATE |
|---|---|
| RW | JULY '86 |
| PL | JULY '86 |
| | |
| GE-H | 18 July '86 |

CLIENT ENERGEX MINERALS LTD.

LOCATION TOODOGGONE, B.C.

KILBORN

PRELIMINARY SITE PLAN

PROJ. NO. 7845-15 | DWG. NO. FIG. 3-2-1 | REV. A

The area selected in the field for the installation of the pads will be cleared and grubbed to remove organics, then rough graded to a uniform slope to permit surface drainage to one side of the pad. The rough grade will be sprayed with a ground sterilant, then covered with a 150 millimetre thick layer of compacted bedding sand (or suitably graded local borrow material). If sand is not readily available, a 200 mil thick geotextile may be substituted to provide puncture resistant bedding under the liner. A 30 mil PVC liner will be placed over the bedding layer. On top of the liner, a 200 mil geotextile cover will be placed to protect the liner during ore placement.

To facilitate the drainage of pregnant solution into the collection trench, a 100 millimetre slotted corrugated, high density polyethylene drain pipe will be placed in a 5 metre by 5 metre grid over the geotextile. Finally, the pipes will be covered with a 300 millimetre layer of minus 38 millimetre oversize ore.

The base of the pad will be sloped toward the pregnant solution collection trench which will be lined with 30 mil PVC.

Diversion ditches will be excavated around the leach pads to minimize the influx of natural surface run-off.

### 3.2.2 Heap Construction

The heaps will each contain 10,000 tonnes of material, and will be 6.1 metres high (see Figure 3.2.2-1). They will be built using a front-end loader and a truck. Care will be exercised to avoid the unnecessary compaction of the material (or physical damage to the liner). Where necessary, a dozer will be used to rip the surface of the heap after one placement or during leaching if ponding occurs.

### 3.2.3 Solution Pond Construction

The pregnant and barren solution ponds will each be 20 metres by 20 metres by 5 metres deep. Berms will be used, in part, to construct sides of the ponds to optimize cut and fill expenses. The slopes of the ponds will be graded, compacted and sterilized prior to covering with a double liner of 30 mil PVC, 150 mil geotextile and 30 mil Hypalon.

Diversion ditches will protect the ponds from natural surface drainage.

Once all 3 heaps are being leached, approximately 37.4 cubic metres per hour of pregnant solution will be produced. The solution ponds will each be capable of containing one day's inventory of solution. In addition, the ponds will accommodate a 50 millimetre rainfall assumed to fall in a 24-hour period. A one metre freeboard allowance will be included in each pond.

### 3.2.4 Carbon Adsorption and Gold Extraction

The carbon adsorption, carbon stripping and electrolytic gold extraction processes will be conducted using leased, modularized plants. Apart from the supply of the normal services and a graded site, no major site preparation will be required.

## 3.3 CRUSHING

Ore will be delivered from the open-pit to a 460 millimetre by 910 millimetre jaw crusher by means of a Volvo BM truck. Alternatively, the truck may dump onto the run-of-mine ore stockpile from which a loader-backhoe will transport the ore to the crusher.

The jaw crusher will be covered by a 460 millimetre slotted grizzly. The 100 millimetre crusher discharge will be delivered by conveyor to a 910 millimetre by 1820 millimetre vibrating screen. The nominal 19-millimetre screen undersize fraction will be delivered by conveyor belt to the crushed ore stockpile. The screen oversize will feed a 600 millimetre cone crusher, the discharge of which will be fed onto the vibrating screen by means of 2 conveyor belts.

A civil contractor in Smithers owns a larger plant than that described above. He would be able to lease the plant for a 3-month period, given sufficient notice. The plant would be well-suited for the work.

## 3.4 HEAP LEACHING

Solution will be applied to the surface and sides of the heaps using Senninger No. 12 Wobblers. Based upon a design factor of 10 litres per hour per square metre dump base, the average solution flow for each heap will be 12.5 cubic metres per hour. To facilitate circuit control, each dump will be serviced by one solution feed pump. Solution will be distributed to the Senninger Wobblers through high density polyethylene pipe.

The pregnant solution will drain to one corner of the heap, and hence through the slotted pipes into the collection ditch.

Subject to the results of column leaching test work, it is possible that each pile will not be leached continuously. Instead, an intermittent operation will be adopted whereby periods of time will be allowed for the heap to drain and lie dormant.

The time required to effectively leach the minus 19 millimetre material is not yet known. The times scheduled for this

purpose are shown below, based upon the termination of leaching operations at the end of September.

| Heap Number | Total Time Available for Leaching |
|---|---|
| I and II | 92 Days |
| III | 61 Days |

## 3.5 GOLD EXTRACTION

Gold will be recovered from the pregnant solution using the conventional carbon adsorption, carbon stripping and electrolytic extraction processes. The cathodes produced will be melted on-site to produce gold bullion.

Preliminary design calculations indicate that five, 760 millimetre diameter by 244 millimetre high carbon adsorption columns will be required. Once all 3 heaps are in operation, approximately 374 cubic metres per hour of pregnant solution will be pumped to the towers. The amount of carbon to be transferred on a daily basis will vary, subject to the original grade of the heap and the status of the leach cycle. The maximum carbon movement will be in the order of 555 - 700 kilograms per day.

It is assumed that 6,800 grams of gold will be adsorbed on each tonne of carbon. A heated solution of cyanide and sodium hydroxide will strip the precious metal from the carbon. The enriched solution will then constitute the electrolyte in a cell using steel wool as the cathode. Metallic gold will be deposited on the wool which will subsequently be charged with flux into a reverberatory furnace to produce bars of gold bullion.

The design of certain gold recovery plants provides for the carbon loading and stripping operations to be carried out in

the same columns. The scheduling of these independent activities would be determined by the grade of the material in the heap. Section 3.6 of this Report provides preliminary design criteria which could be used to size equipment and facilities for a new plant. In fact, the final selection of process equipment will depend in large part upon the cost and availability of suitable mobile plants which may not conform exactly to the following design criteria.

## 3.6 DESIGN CRITERIA

### Ore

| | | |
|---|---|---|
| Quantity to be Leached | - | 30,000 tonnes |
| Grade of Ore | - | Variable 3.4 - 8.6 gms/tonne (0.10 - .25 ozs/ton |

### Crushing

| | | |
|---|---|---|
| Crushing Rate | - | 10,000 tonnes/month |
| Crushing Schedule | - | 12 hours/shift<br>2 shifts/day<br>6 days/week |
| Effective Time Per Shift | - | 9 hours |
| Plant Availability | - | 80 percent |
| Feed Size (Maximum) | - | 460 mm |
| Product Size (Nominal) | - | Minus 19 mm |

### Leaching

| | | |
|---|---|---|
| Number of Heaps | - | 3 |
| Size of Heaps | - | 10,000 tonnes |
| Duration of Leach: | | |
| Heaps I and II | - | 92 days |
| Heap III | - | 61 days |

| | | |
|---|---|---|
| Bulk Density of Material | - | 1,415 kg/m³ |
| Slope of Piles | - | 45° |
| Leachant Application Rate | - | 10 litres/hour/metre² (0.004 gpm/SF) |
| Gold Recovery | - | Variable (see 'Metallurgy') |

Pregnant and Barren Solution Ponds

| | | |
|---|---|---|
| Number of Ponds | - | One each |
| Capacity | - | One day's inventory each plus emergency freeboard |
| Rainfall | - | 50 mm in 24 hours |
| Evaporation Rate | - | Assume zero |
| Barren Solution Flow Rate | - | 12.5 m³/h |

Gold Extraction

| | | |
|---|---|---|
| Schedule | - | Continuous operation |
| Carbon Column Solution Flow | - | 73.4 m³/h/m² |
| Carbon Loading | - | 6,800 gm gold/tonne carbon |
| Carbon Transfers (Maximum) | - | 4 daily |
| Carbon Bed Expansion Factor | - | 250% |
| Number of Columns | - | 5 |
| Number of Electrolytic Cells | - | 2 |

Gold Refining

| | | |
|---|---|---|
| Schedule | - | One shift/week |

Metallurgy

| Feed Ozs/Ton | Grade Gm/Tonne | Gold* Recovery % |
|---|---|---|
| 0.25 | 8.57 | 75 |
| 0.20 | 6.86 | 71 |
| 0.15 | 5.14 | 63 |
| 0.10 | 3.43 | 48 |

* Recovery achieved in 92 days, i.e. July, August and September.

## 3.7 GOLD PRODUCTION

Preliminary gold production estimates have been prepared based upon 4 feed grades:

| Feed Grade | |
|---|---|
| Ozs Gold/Ton | Gm Gold/Tonne |
| 0.25 | 8.57 |
| 0.20 | 6.86 |
| 0.15 | 5.14 |
| 0.10 | 3.43 |

It is reported that 30,000 tonnes of material could be selectively mined to produce heaps within this range of grades.

No heap leach or column leach test work has been conducted to date. Accordingly, gold production estimates are predicated upon assumed gold recoveries. For this purpose, it is assumed that a 75 percent gold extraction will be achieved when 0.25 ounces of gold per ton (8.57 grams of gold per tonne) of material is leached during the 92-day period, July - September, inclusive. Estimates of gold extractions at lower

feed grades are derived using the assumed tailings values shown in Table 3.7-1.

TABLE 3.7-1
ASSUMED TAILINGS VALUES AND GOLD RECOVERIES

| Feed Grade | | Nominal Tailings | Gold Recovery |
|---|---|---|---|
| Ozs Au/Ton | Gm/Tonne | Gm/Tonne | % |
| 0.25 | 8.57 | 2.1 | 75 |
| 0.20 | 6.86 | 2.0 | 71 |
| 0.15 | 5.14 | 1.9 | 63 |
| 0.10 | 3.43 | 1.8 | 48 |

Assumed Gold Extraction versus Time Curve profiles, Figures 3.7-1 to 3.7-4, are used to develop projected gold recoveries by period. A summary of the total gold production is shown in Table 3.7-2.

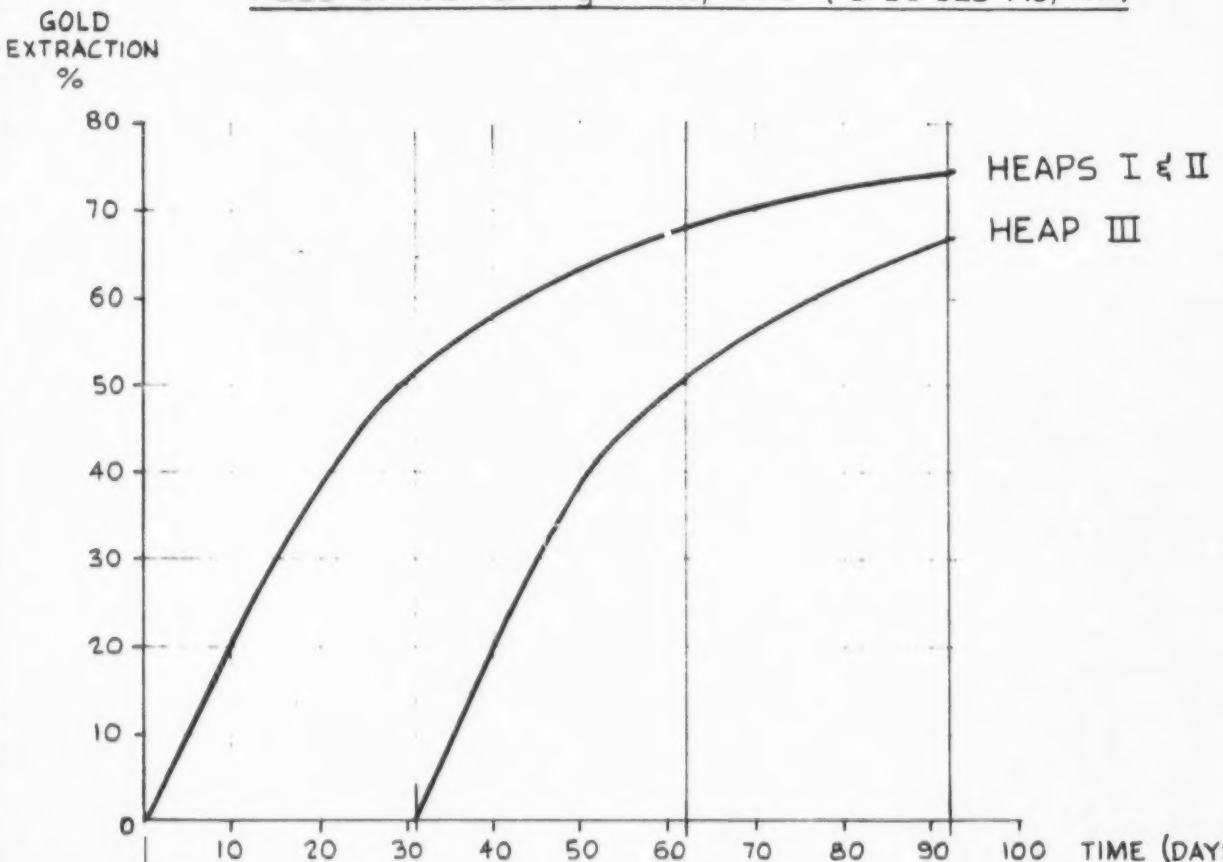
TABLE 3.7-2
GOLD PRODUCTION SUMMARY

| Feed Grade Ozs/Ton | Total Production Ozs of Gold | Total Gold Extraction % |
|---|---|---|
| 0.25 | 5,425 | 72.3 |
| 0.20 | 4,120 | 68.7 |
| 0.15 | 2,730 | 60.7 |
| 0.10 | 1,380 | 45.9 |

## 3.8 EFFLUENT TREATMENT

Due to the lack of meterological data on precipitation, a detailed solution balance has not been calculated for the process.

FEED GRADE: 8.57 gm Au/tonne (0.25 ozs Au/ton)




| HEAP | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. |
|---|---|---|---|---|---|---|---|---|
| I & II | 52.0 | 2600 | 15.0 | 750 | 8.0 | 400 | 75.0 | 3750 |
| III | — | — | 52.0 | 1300 | 15.0 | 375 | 67.0 | 1675 |
| TOTAL | 34.7 | 2600 | 27.3 | 2050 | 10.3 | 775 | 72.3 | 5425 |

| | | |
|---|---|---|
| TITLE: GOLD PRODUCTION ESTIMATE | SECTION: MINING | |
| KILBORN ENGINEERING (B.C.) LTD. | AREA NO: | REV. NO: |
| CLIENT: ENERGEX MINERALS LTD. PROJECT NO: 7845-15 | DRAWING NO: FIG. 3.7-1 | |
| APPROVED: DATE: JULY 18, 1986 | | |

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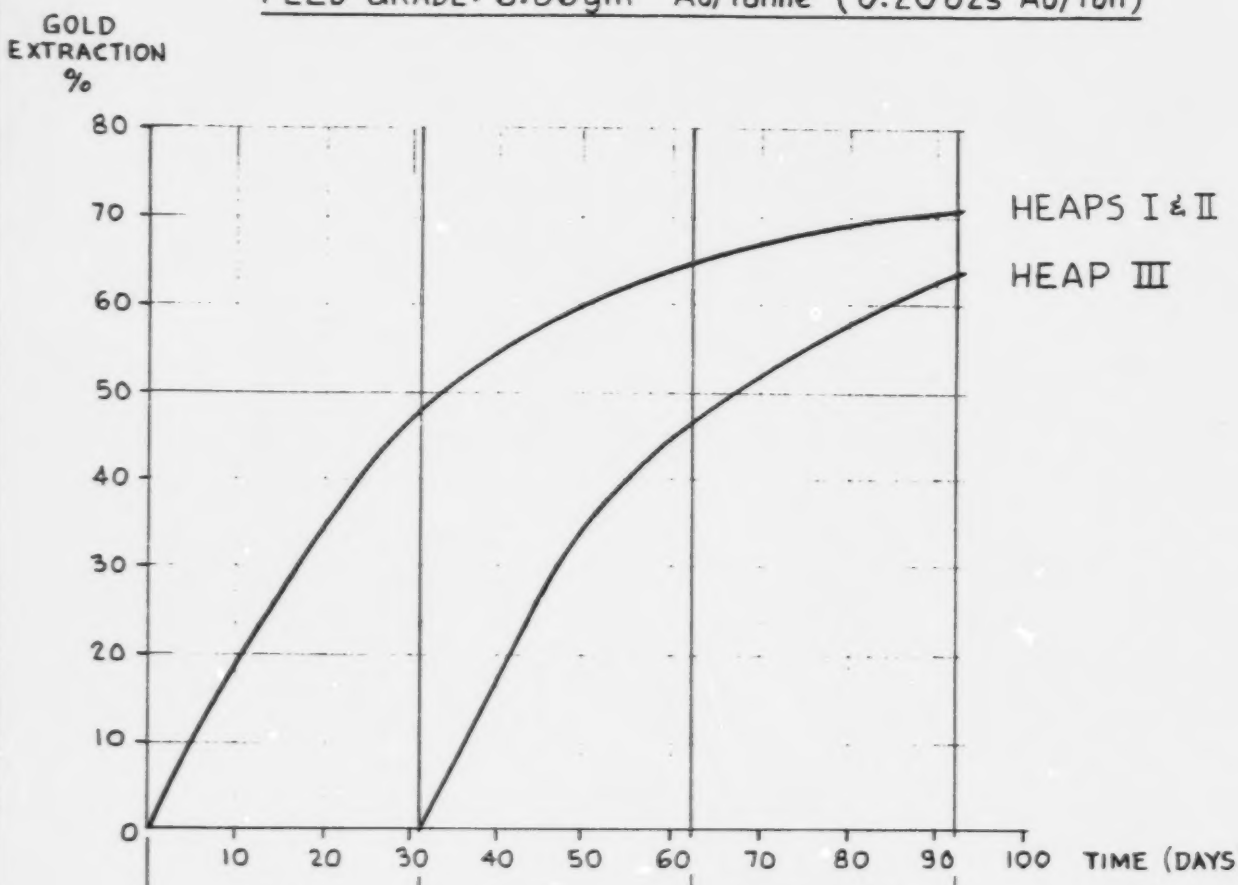
FEED GRADE: 6.86gm Au/tonne (0.20ozs Au/ton)




| | JULY | | AUGUST | | SEPTEMBER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|
| HEAP | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. |
| I & II | 48.0 | 1920 | 16.0 | 640 | 7.0 | 280 | 71.0 | 2840 |
| III | — | — | 48.0 | 960 | 16.0 | 320 | 64.0 | 1280 |
| TOTAL | 32.0 | 1920 | 26.7 | 1600 | 10.0 | 600 | 68.7 | 4120 |

| | | |
|---|---|---|
| TITLE: GOLD PRODUCTION ESTIMATE | SECTION: MINING | |
| KILBORN ENGINEERING (B.C.) LTD. | AREA NO: | REV. NO: |
| CLIENT: ENERGEX MINERALS LTD. PROJECT NO: 7845-15 | DRAWING NO: FIG. 3.7-2 | |
| APPROVED: DATE: JULY 18, 1986 | | |

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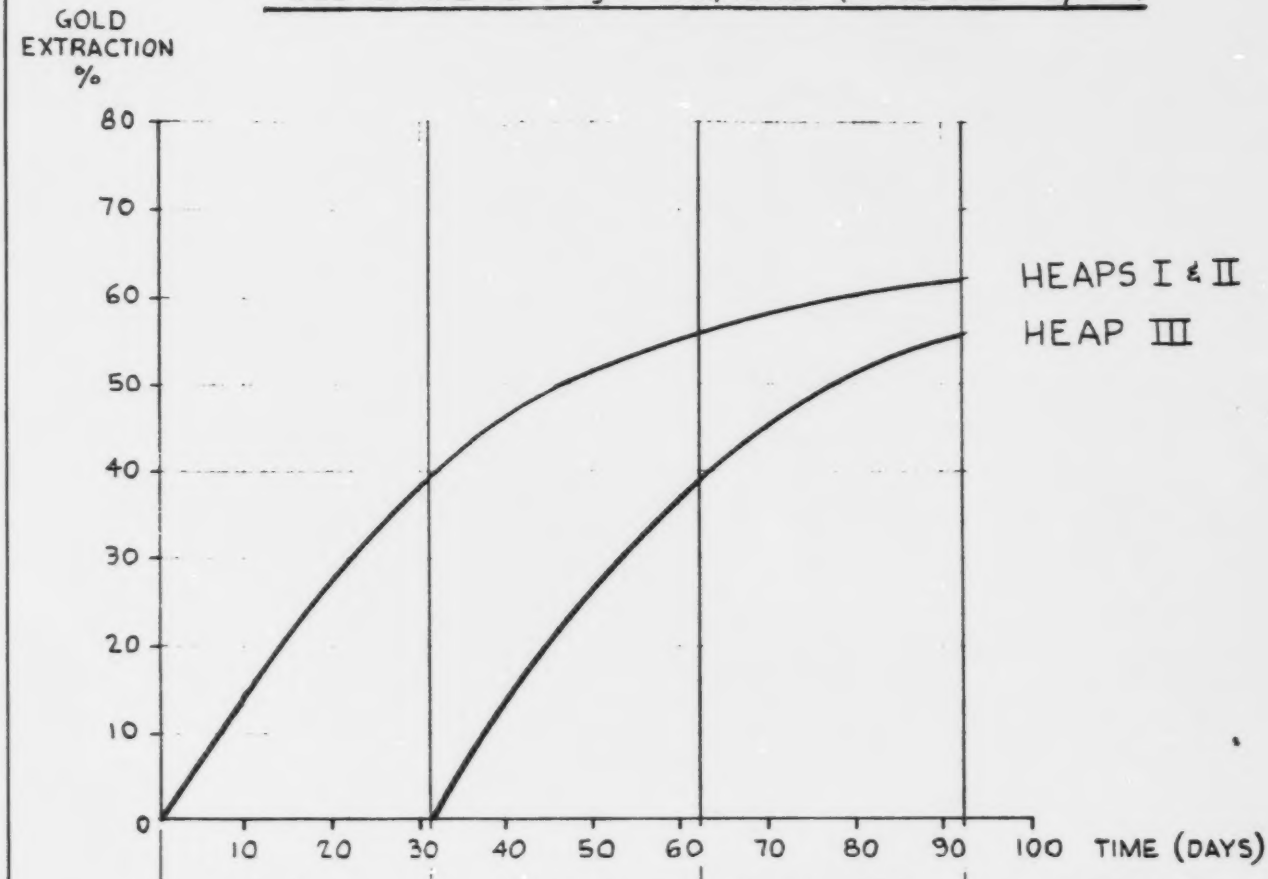
FEED GRADE: 5.14 gm Au/tonne ( 0.15 ozs Au/ton)




| | JULY | | AUGUST | | SEPTEMBER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|
| HEAP | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. |
| I & II | 40.0 | 1200 | 16.0 | 480 | 7.0 | 210 | 63.0 | 1890 |
| III | — | — | 40.0 | 600 | 16.0 | 240 | 56.0 | 840 |
| TOTAL | 26.7 | 1200 | 24.0 | 1080 | 10.0 | 450 | 60.7 | 2730 |

| | | |
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| TITLE: GOLD PRODUCTION ESTIMATE | SECTION: MINING | |
| KILBORN ENGINEERING (B.C.) LTD. | AREA NO: | REV. NO: |
| CLIENT: ENERGEX MINERALS LTD PROJECT NO: 7845-15 | DRAWING NO: FIG. 3.7-3 | |
| APPROVED: DATE: JULY 18, 1986 | | |

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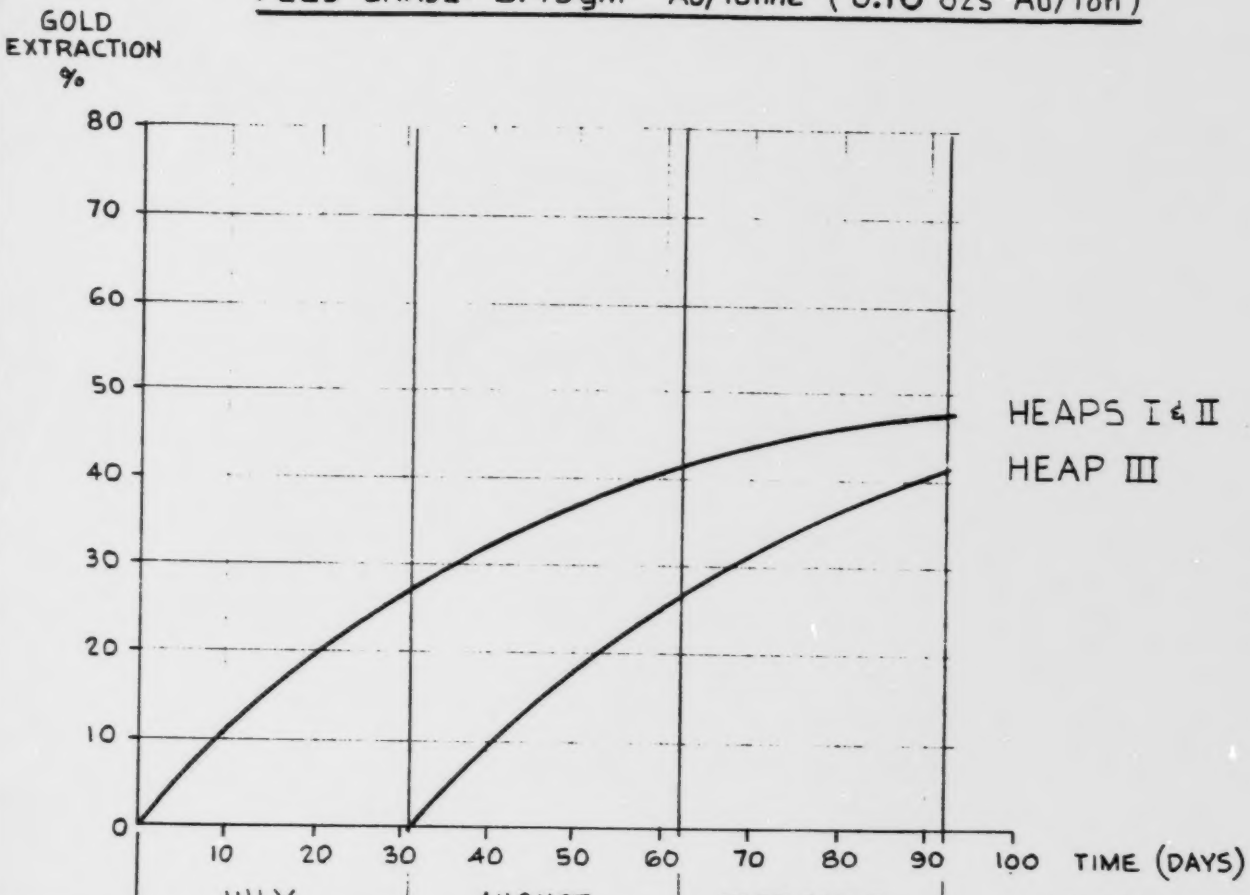
## FEED GRADE: 3.43gm Au/tonne (0.10 ozs Au/ton)




| | JULY | | AUGUST | | SEPTEMBER | | TOTAL | |
|---|---|---|---|---|---|---|---|---|
| HEAP | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. | REC.% | OZS. |
| I & II | 26.0 | 520 | 16.0 | 320 | 6.0 | 120 | 48.0 | 960 |
| III | — | — | 26.0 | 260 | 16.0 | 160 | 42.0 | 420 |
| TOTAL | 17.3 | 520 | 19.3 | 580 | 9.3 | 280 | 45.9 | 1380 |

| | | |
|---|---|---|
| TITLE: GOLD PRODUCTION ESTIMATE | SECTION: MINING | |
| KILBORN ENGINEERING (B.C.) LTD. | AREA NO: | REV. NO: |
| CLIENT: ENERGEX MINERALS LTD. PROJECT NO: 7845-15 | DRAWING NO: FIG. 3.7-4 | |
| APPROVED: DATE: JULY 18, 1986 | | |

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It is probable that all conceivable measures should be taken to minimize the gain in solution inventory due to precipitation. Such items would include:

(a) Siting the heaps on elevated ground to prevent the ingress of natural surface run-off water.

(b) Covering the solution collection ditches and areas of the heaps which are not being sprayed.

(c) Covering the heaps during the winter season.

(d) Covering solution ponds.

(e) Minimizing initial inventory of solution and allowing system to build up solution over the leaching period by gains from precipitation.

Since the amount of effluent which might be generated cannot be quantified at this time, no provision is included for effluent treatment. However, it is proposed that sodium hypochlorite would be added to the barren pond decant. A small aging pond would be required to allow for the completion of the cyanide destruction process. Discharges would be periodic rather than continuous. The associated capital and operating costs would likely fall within the overall estimates unless some extraordinary metallurgical problems were to be encountered.

# 4.0 DEVELOPMENT SCHEDULE

# 4.0 DEVELOPMENT SCHEDULE

## 4.1 RECOMMENDED PROGRAM

The preliminary development schedule is shown in bar chart form in Figure 4.1-1.

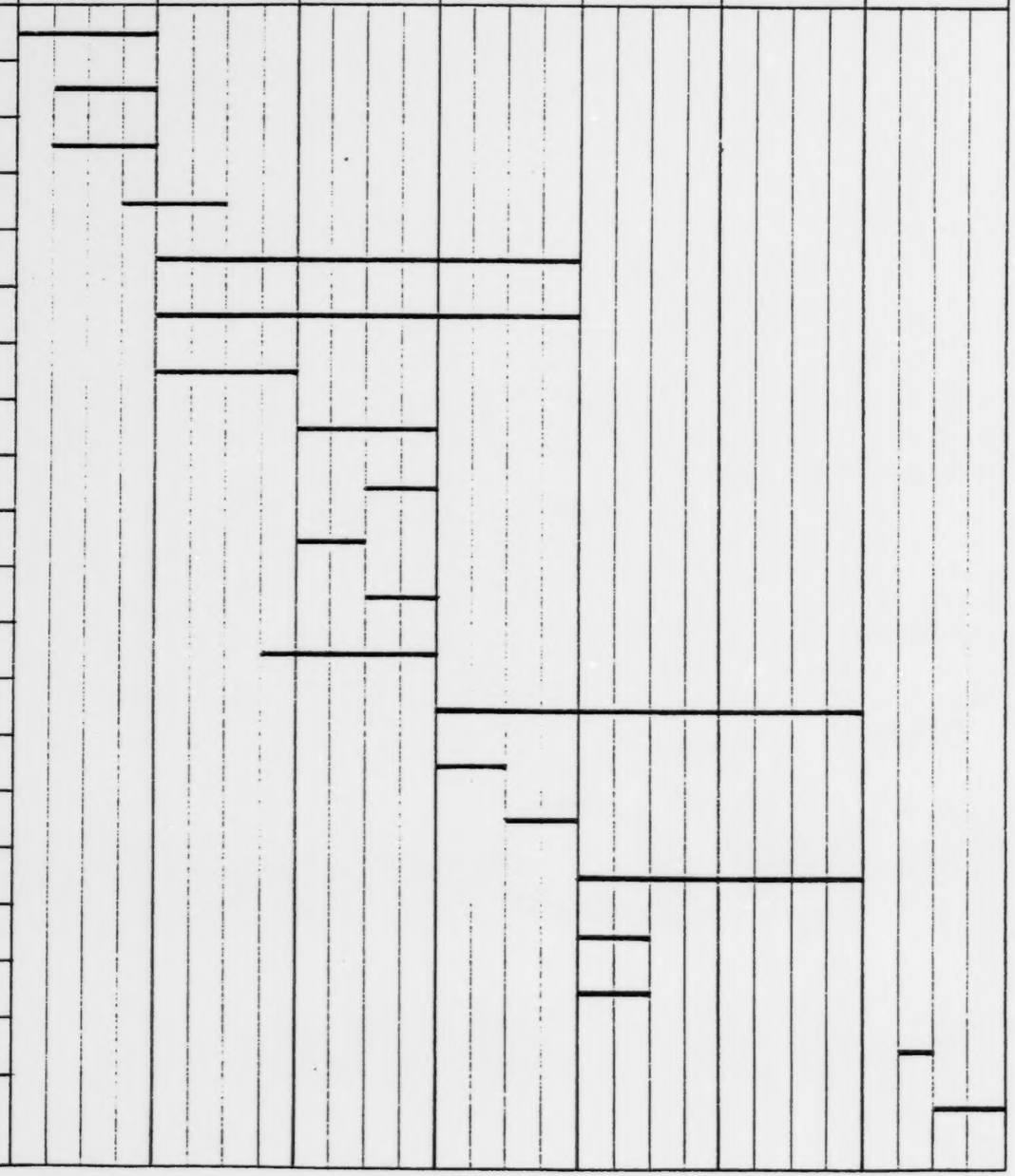
The camp and general infrastructure requirements will be established in April. Access routes will be prepared, and the landing strip made operational. While some supplies will be delivered by Hercules aircraft, the major items of mobile and process equipment will be transported to the site by cat train. In view of the site location, it is important that the logistics of mobilization and demobilization be studied in depth as an integral part of subsequent and more detailed studies.

Open-pit pre-production stripping will commence in late April, and be completed by mid-May. Open-pit mining will commence on April 1, and continue until the end of July. Crushing operations will be carried out concurrently.

The solution ponds, drainage ditches and leach pads for 2 piles will all be constructed during May and June. During this period, fresh water supply systems and piping and reagent feeding circuits will also be prepared. The modularized gold extraction plant will be set up and commissioned in preparation for the commencement of leaching operations on July 1. The leaching of piles I and II will start at this time and proceed until September 30.

The preparation of the No. III pad and leach pile will take place during July. Leaching of this pile will commence August 1 and continue until September 30, at which time all leaching operations will be terminated. Residual solutions

| | ACTIVITY |
|---|---|
| 1 | Establish camp & infrastructure |
| 2 | Mobilize mining equipment |
| 3 | Mobilize crushing plant |
| 4 | Pre-production stripping |
| 5 | Mining |
| 6 | Crushing |
| 7 | Prepare #I & #II leach pads |
| 8 | Construct solution ponds, ditches etc. |
| 9 | Install tankage, pumps etc. |
| 10 | Mobilize gold extraction plant |
| 11 | Commission gold extraction plant |
| 12 | Construct #I & #II heaps |
| 13 | Leach #I & #II heaps |
| 14 | Prepare #III leach pad |
| 15 | Construct #III heap |
| 16 | Leach #III heap |
| 17 | Demobilize mining equipment |
| 18 | Demobilize crushing plant |
| 19 | Demobilize gold extraction plant |
| 20 | Demobilize remaining mobile equipment, generators etc. & close camp |

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| REVISIONS | NO | DATE | BY |
|---|---|---|---|
| ISSUED FOR REPORT | A | JUL 18 86 | |

SCALE NONE | DATE
DESIGNED P.T. | JULY 86
DRAWN J. Farkas | JULY 7 86
CHECKED
APPROVED | JULY 18 86

CLIENT ENERGEX MINERALS LTD
VANCOUVER B.C.
LOCATION TOODOGGONE B.C.

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# PRELIMINARY DEVELOPMENT SCHEDULE

PROJ. NO 7845-15 | DWG. NO. FIG. 4.1-1 | REV. A

which may contain cyanide will then be treated with liquid sodium hypochlorite.

The demobilization of the equipment and facilities will take place during September and October. It is anticipated that cat trains will have little difficulty leaving the site by the end of September.

# 5.0 PROJECT COST ESTIMATE

# 5.0 PROJECT COST ESTIMATE

## 5.1 SUMMARY

The Project costs, by principal area of expense, are shown below in Table 5.1-1.

TABLE 5.1-1
PROJECT COST SUMMARY - $(000)

| Area of Expense | April | May | June | July | Aug. | Sept. | Oct. | Total |
|---|---|---|---|---|---|---|---|---|
| Mining | | 250 | 250 | 250 | | | | 750 |
| Processing | 44 | 242 | 204 | 267 | 218 | 222 | 34 | 1,231 |
| Power Supply | | | | 4 | 8 | 8 | | 20 |
| General and Admin. | 15 | 24 | 9 | 9 | 9 | 9 | | 75 |
| TOTAL | 59 | 516 | 463 | 530 | 235 | 239 | 34 | 2,076 |

## 5.2 MINING

The Mine Operating Costs used in this Study have been developed by Arthur T. Fisher & Associates Ltd. in a report dated June 27, 1986.

The data shown in Table 5.2-1 overleaf, extracted directly from Mr. Fisher's report, summarize the Mine Operating Costs.

TABLE 5.2-1

MINE OPERATING COST SUMMARY

| Item | Period | Total Cost $ | Cost/Tonne of Ore Mined ($/Tonne) |
|---|---|---|---|
| Heavy Equipment | 3 Months | 258,000 | 8.60 |
| Consumables | - | 300,000 | 10.00 |
| Labour | 3 Months | 135,000 | 4.50 |
| SUBTOTAL | | 683,000 | 22.10 |
| Plus Contingency Allowance at 10% | | 68,300 | 24.31 |
| TOTAL REQUIRED BUDGET | | 751,300 | 24,31 |
| Say | | 750,000 | 25.00 |

## 5.3 PROCESSING

### 5.3.1 Processing Cost Summary

The Processing Cost Estimate is summarized in Table 5.3.1-1.

TABLE 5.3.1-1
PROCESSING COST SUMMARY - $(000)

| Area of Expense | April | May | June | July | Aug. | Sept. | Oct. | Total |
|---|---|---|---|---|---|---|---|---|
| Labour | 14.4 | 33.8 | 47.2 | 48.7 | 33.8 | 33.1 | 33.8 | 244.8 |
| Equipment Lease Costs: | | | | | | | | |
| a) Mobile Equipment | - | 64.4 | 49.9 | 60.9 | 10.9 | 14.9 | - | 201.0 |
| b) Crushing Plant | 30.0 | 35.0 | 35.0 | 35.0 | 25.0 | - | - | 160.0 |
| c) Gold Extraction | - | 47.0 | 22.0 | 22.0 | 22.0 | 47.0 | - | 160.0 |
| Construction Supplies | - | 62.0 | 50.0 | 15.9 | - | - | - | 127.9 |
| Operating Supplies | - | - | - | 84.4 | 126.6 | 126.6 | - | 337.6 |
| TOTAL | 44.4 | 242.2 | 204.1 | 266.9 | 218.3 | 221.6 | 33.8 | 1231.3 |

### 5.3.2 Labour

For this purpose, it is assumed that all operating personnel will work a 12-hour shift on a '2-week on - 2-week off' schedule which results in a 42-hour work week. Continuous coverage will be maintained, 24 hours per day, 7 days per week.

Overtime, at the rate of 1.5 multiplied by the base rate will be paid for all hours in excess of 40 hours per week.

The weighted average base rate will be $13.50 per hour. A 20 percent loading is provided to cover Workmen's Compensation Premiums, Unemployment Insurance and Canada Pension payments.

Employees will be housed in exploration-type tents. The room and board charge will be $35 per man day.

The return air fare from Smithers to the Sturdee airstrip will be $97.

The deduction of a composite wage rate is shown in Table 5.3.2-1, based upon the foregoing assumptions.

TABLE 5.3.2-1
COMPOSITE WEIGHTED AVERAGE WAGE RATE

| Item | Cost $/Hour Worked |
|---|---|
| Base Rate | 13.50 |
| Scheduled Overtime | 0.32 |
| Loading: 20% of Base | 2.70 |
| Room and Board: $35 Per Day | 2.92 |
| Transportation to Site | 0.58 |
| TOTAL | 20.02 |

One Metallurgist will be on site throughout the duration of the Project. He will receive a loaded monthly salary of $4,000. Two Equipment Operators will prepare the heap pads, construct the heaps and build the solution ponds during May, June and July. Thereafter, one Equipment Operator will be retained on site to provide general site services.

Two Process Operators will work in June to assist in the installation of pumps and piping systems and the set-up of the gold extraction plant. The two operators, one per shift, will

monitor the leach piles and operate the gold extraction plant during July, August and September. One operator will assist in the decommissioning of the facilities in October.

One Utility Labourer will be on site during the period April - July, inclusive, to assist in setting up the process equipment and site preparation.

One Mechanic/Electrician will be on site throughout the Project to service all equipment associated with the processing activities.

The labour cost estimate is shown overleaf in Table 5.3.2-2.

TABLE 5.3.2-2
LABOUR COST ESTIMATE

| ITEM | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | TOTAL COST |
|---|---|---|---|---|---|---|---|---|
| LABOUR REQUIREMENT ON-SITE: | | | | | | | | |
| Metallurgist/Supervisor | - | 1 | 1 | 1 | 1 | 1 | 1 | |
| Equipment Operator | - | 2 | 2 | 2 | 1 | 1 | 1 | |
| Process Operator | - | - | 2 | 2 | 2 | 2 | 1 | |
| Labourer | 1 | 1 | 1 | 1 | - | - | - | |
| Mechanic/Electrician | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| TOTAL MANPOWER ON-SITE | 2 | 5 | 7 | 7 | 6 | 6 | 5 | |
| LABOUR COSTS ($): | | | | | | | | |
| Metallurgist/Supervisor | - | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 24,000 |
| Equipment Operator | - | 14,895 | 14,414 | 14,895 | 7,447 | 7,447 | 7,447 | 66,545 |
| Process Operator | - | - | 14,414 | 14,895 | 14,895 | 14,414 | 14,895 | 73,513 |
| Labourer | 7,207 | 7,447 | 7,207 | 7,447 | - | - | - | 29,308 |
| Mechanic/Electrician | 7,207 | 7,447 | 7,207 | 7,447 | 7,447 | 7,207 | 7,447 | 51,409 |
| TOTAL LABOUR COSTS | 14,414 | 33,789 | 47,242 | 48,684 | 33,789 | 33,068 | 33,789 | 244,775 |



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## 5.3.3 Equipment Lease and Operating Costs

### (a) Mobile Equipment

The following items of mobile equipment will be required to prepare the site and construct the heap leach pads:

| Item | Quantity | Description |
|---|---|---|
| 1 | 1 | D-6 or Equivalent Bulldozer |
| 2 | 1 | Rubber-Tired Loader-Backhoe - JCB-3D |
| 3 | 1 | Volvo BM Truck |

A preliminary estimate of the associated costs is shown overleaf in Table 5.3.3-1.

### (b) Crushing Plant

A crushing plant is currently available in Smithers which would be capable of crushing the run-of-mine material to 19 millimetres. The owner of the equipment would be willing to lease the plant for $20,000 per month, and would wish to provide 2 of his employees to operate and maintain the equipment.

An approximate estimate of the crushing plant costs is shown overleaf in Table 5.3.3-2.

### (c) Gold Extraction Plant

Skid-mounted, modularized gold extraction plants are available for lease. A budget quotation reviewed for a plant of required capacity has been received for approximately $22,000 per month. It is probable that this cost could be reduced once finite production plans have been established.

TABLE 5.3.3-1

EQUIPMENT LEASE AND OPERATING COSTS ($)

| ITEM | APRIL | MAY | JUNE | JULY | AUGUST | SEPT. | OCT. | TOTAL |
|---|---|---|---|---|---|---|---|---|
| 1. Bulldozer - D-6 Cat | | | | | | | | |
| Mobilization/Demobilization | - | 6,000 | - | 6,000 | - | - | - | 12,000 |
| Fuel/Lube | - | 2,500 | 2,500 | 2,500 | - | - | - | 7,500 |
| Lease Cost | | 20,000 | 20,000 | 20,000 | - | - | - | 60,000 |
| 2. Loader-Backhoe - JCB-3D | | | | | | | | |
| Mobilization/Demobilization | - | 4,500 | - | - | - | 4,500 | - | 9,000 |
| Fuel/Lube | - | 1,875 | 1,875 | 1,875 | 1,875 | 1,875 | - | 9,375 |
| Lease Cost | - | 7,500 | 7,500 | 7,500 | 7,500 | 7,500 | - | 37,500 |
| 3. Truck - Volvo BM | | | | | | | | |
| Mobilization/Demobilization | - | 5,000 | - | 5,000 | - | - | - | 10,000 |
| Fuel/Lube | - | 3,500 | 3,500 | 3,500 | - | - | - | 10,500 |
| Lease Cost | - | 12,000 | 12,000 | 12,000 | - | - | - | 36,000 |
| SUBTOTAL | - | 62,875 | 47,375 | 58,375 | 9,375 | 13,875 | - | 191,875 |
| Repair Supplies | - | 1,500 | 2,500 | 2,500 | 1,500 | 1,000 | - | 9,000 |
| TOTAL | - | 64,375 | 49,875 | 60,875 | 10,875 | 14,875 | - | 200,875 |

TABLE 5.3.3-2

CRUSHING PLANT COSTS ($)

| ITEM | APRIL | MAY | JUNE | JULY | AUGUST | SEPT. | OCT. | TOTAL |
|---|---|---|---|---|---|---|---|---|
| Crusher Mobilization/ Demobilization | 20,000 | - | - | - | 20,000 | - | - | 40,000 |
| Operating Labour | - | 15,000 | 15,000 | 15,000 | - | - | - | 45,000 |
| Lease Payments | 10,000 | 20,000 | 20,000 | 20,000 | 5,000 | - | - | 75,000 |
| TOTAL CRUSHING PLANT COSTS | 30,000 | 35,000 | 35,000 | 35,000 | 25,000 | - | - | 160,000 |



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The plant includes 5-stage carbon columns, trash, carbon and safety screens, all interconnecting piping and pumps. A complete carbon stripping and electrowinning plant and a reverberatory furnace is also included.

Mobilization and demobilization costs are assumed to be $25,000, respectively.

### 5.3.4 Construction Supplies

The Construction Supply Costs, shown overleaf in Table 5.3.4-1, will be incurred, based upon the Site Plant shown in Figure 5.3.4-1. For this purpose, it is assumed that all construction supplies are purchased by Energex.

### 5.3.5 Operating Supplies

Sodium cyanide will be used to leach gold from the heaps and to 'strip' gold from the loaded carbon.

Sodium hydroxide will provide the necessary solution alkalinity during the heap leaching and carbon stripping processes. Carbon will be required initially to charge the 5 carbon columns. Thereafter, only a small quantity of carbon will be required to replace the fines which will be removed in the gold extraction plant.

Fuel oil will be consumed to heat the carbon reactivation kiln and the reverberatory furnace. The costs of oil required for general heating purposes are assumed to be included in the camp cost. An allowance is included to cover the cost of flux, fuel oil for the reverberatory furnace and other miscellaneous operating supplies.

## TABLE 5.3.4-1
## CONSTRUCTION SUPPLIES

| AREA OF EXPENSE | ITEM | QTY. | UNITS | COST PER UNIT $ | TOTAL COST $ |
|---|---|---|---|---|---|
| Leach Pad | Geotextile 200 mil | 8,250 | m² | 3.50 | 28,875 |
| | PVC Liner 30 mil (Pad and Trenches) | 9,000 | m² | 4.25 | 38,250 |
| | 100 mm dia PVC Slotted Drain Pipes | 1,500 | m | 9.50 | 14,250 |
| | 50 mm dia HDPE Spray Solution Headers | 180 | m | 2.50 | 450 |
| | 25 mm dia HDPE Spray Solution Laterals | 1,650 | m | 1.90 | 3,135 |
| | Sprinkler Heads complete with Pressure Regulators - Senninger No. 12 | 300 | Each | 12.00 | 3,600 |
| Solution Ponds | PVC Liner 30 mil | 960 | m² | 4.25 | 4,080 |
| | Hypalon Liner 30 mil to Solution Ponds | 960 | m² | 7.00 | 6,720 |
| | Geotextile - 200 mil | 960 | m² | 3.50 | 3,360 |
| | Pregnant Solution Pump | 2 | Each | 3,500.00 | 7,000 |
| | Pregnant Solution Valves, Pipe Fittings | 1 | Lot | 2,000.00 | 2,000 |
| | Barren Solution Pump | 2 | Each | 3,500.00 | 7,000 |
| | Barren Solution Valves, Pipe Fittings | 1 | Lot | 2,000.00 | 2,000 |
| Fresh Water Pond | PVC Liner 30 mil | 400 | m² | 4.25 | 1,700 |
| | Pump | 1 | Each | 2,500.00 | 2,500 |
| | Fresh Water Valves, Pipe, Fittings | 1 | Lot | 500.00 | 500 |
| Other | Fuel Storage, 37,000 litre Capacity (Used) | 1 | Lot | 2,500.00 | 2,500 |
| TOTAL | | | | | 127,920 |

The prices of supplies are based upon current 'budget' quotations on an FOB, Vancouver basis. It is assumed that the supplies will then be transported to Smithers ($248 per tonne), and hence to the site by air ($662 per tonne). The total freight cost from Vancouver to the Sturdee airstrip will be $910 per tonne ($0.91 per kilogram).

For this purpose, the cost of operating supplies is assumed to vary directly with the tonnage to be leached. The unit cost (dollars per tonne leached) is derived in Table 5.3.5-1.

TABLE 5.3.5-1
OPERATING SUPPLY UNIT COSTS

| Item | Consumption Kg/Tonne | Price $/Kg FOB Vanc. | Price $/Kg FOB Site | Unit Cost $/Tonne Leached |
|---|---|---|---|---|
| Sodium Cyanide | 0.85 | 1.74 | 2.65 | 2.25 |
| Sodium Hydroxide | 0.85 | 0.88 | 1.79 | 1.52 |
| Carbon | 0.05 | 3.51 | 4.42 | 0.22 |
| Other - Allowance | - | - | - | 0.23 |
| TOTAL | | | | 4.22 |

## 5.4 POWER SUPPLY

### 5.4.1 Power Requirement

The incremental power requirement is estimated to be one kilowatt hour per tonne.

The power will be produced by means of a diesel-electric generator which will produce approximately 3 kilowatt hours per litre of fuel oil. The cost of fuel oil is assumed to be $0.66 per litre ($3.00 per gallon).

It is assumed that the power generator required for the exploration camp will be of sufficient size to generate the minimal amount of incremental power required for the processing operations. These costs do not include power for the crushing plant which will be a self-contained unit, complete with an integral diesel-electric generator.

The unit cost of energy will therefore be:

$$\frac{1.0 \times 0.66}{3} = \$0.22 \text{ per tonne.}$$

## 5.5 GENERAL AND ADMINISTRATIVE

The General and Administrative costs are summarized in Table 5.5-1.

TABLE 5.5-1
GENERAL AND ADMINISTRATIVE COSTS

| Item | April | May | June | July | Aug. | Sept. | Oct. | Total |
|---|---|---|---|---|---|---|---|---|
| Consulting Services | - | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | - | 25,000 |
| Assay Facilities | 15,000 | 15,000 | - | - | - | - | - | 30,000 |
| Assay Labour | - | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | - | 20,000 |
| TOTAL | 15,000 | 24,000 | 9,000 | 9,000 | 9,000 | 9,000 | - | 75,000 |

No additional management personnel will be required on-site as a result of the Heap Leach Project.

An allowance of $5,000 per month during the period May to September is included for mine and process engineering consulting services.

It will be necessary to analyze pregnant and barren solutions for process control purposes throughout the leaching program. Samples of blast-hole drill cuttings will be assayed for ore control purposes. A temporary laboratory will be established in a tent or in a small trailer. An allowance of $10,000 is included to cover the costs of installing a ventilation fan, working bench and plumbing. In addition, a small oil free air compressor and dedicated power generator will be required. An atomic adsorption analyzer will be purchased for $20,000. The assayer will set-up the laboratory in May and operate the facility until the end of September. The assayer's loaded salary will be $4,000 per month.

# 6.0 PROJECT ECONOMICS

# 6.0 PROJECT ECONOMICS

## 6.1 ASSUMPTIONS

The purpose of the following calculations is to determine the range of feed grades and gold prices which will permit Energex to heap leach 30,000 tonnes of material and generate a positive cash flow. For this purpose only, it is assumed that such favourable conditions exist when the value of the estimated gross value of production exceeds the projected operating costs.

Gold production data is derived in Section 3.7 of this Study. A base gold price of $340 U.S. per ounce is assumed. The sensitivity of Project economics to variations in gold price is examined through the use of alternative gold prices.

| Gold Price $ U.S./Oz | % of Base |
|---|---|
| 306 | 90 |
| 340 | Base |
| 374 | 110 |
| 391 | 115 |

The exchange rate is assumed to be: $1.00 U.S. equals $1.40 Canadian.

The operating cost projections are derived in Section 5.0 of this Study. It is assumed that certain overhead costs will be charged to the normal exploration account. Thus, costs incurred in maintaining access roads, providing adequate supplies of fresh water, general site maintenance and head office overhead are not included in these costs. The Heap Leaching Project is not, therefore, examined on a 'stand-alone' basis.

To be consistent with studies performed by others, it is assumed that large items of process and mobile equipment will be moved to the site over land by cat train. It is further assumed that the equipment will leave the site by the same route, once it is no longer required for the heap leach operation. Alternatively, some equipment may remain on-site to be used in the ongoing Project development activities.

The Project economics are simply examined on a 'Value of Production Less Costs' basis. No provision is included for interest expense, taxes and the other important elements which comprise a Financial Evaluation.

## 6.2 ANALYSIS OF RESULTS

The results of studies, summarized in Table 6.2-1, indicate that at a gold price of $340 per ounce a positive cash flow can be generated at grades in excess of about 0.2 ounces of gold per ton (or 6.9 grams of gold per tonne). The data is represented graphically in Figure 2.1, Section 2.0 of this Report.

It should be pointed out that these economics are related to the short leaching season assumed. Any extension of this season, or continued recovery in subsequent seasons, will improve the economics. Rest periods for heaps between leaches are often beneficial to overall recovery.

TABLE 6.2-1

GROSS VALUE OF PRODUCTION

EXCHANGE RATE: $1.00 U.S. = $1.40 CDN.

| FEED GRADE | | PRODUCTION | GOLD PRICE | GROSS VALUE OF PRODUCTION | VALUE OF PRODUCTION LESS PROJECT COSTS | |
|---|---|---|---|---|---|---|
| OZS AU/TON | GMS AU/TONNE | OZS | $ U.S./OZ | $ CDN | $ CDN | $/TONNE LEACHED |
| 0.25 | 8.57 | 5,425 | 306 | 2,324,070 | 248,070 | 8.27 |
| | | | 340 | 2,582,300 | 506,300 | 16.88 |
| | | | 374 | 2,840,530 | 764,000 | 25.47 |
| | | | 391 | 2,969,645 | 893,645 | 29.79 |
| 0.20 | 6.86 | 4,120 | 306 | 1,765,008 | (310,992) | - |
| | | | 340 | 1,961,120 | (114,880) | - |
| | | | 374 | 2,157,232 | 81,232 | 2.71 |
| | | | 391 | 2,255,288 | 179,288 | 3.72 |
| 0.15 | 5.14 | 2,730 | 306 | 1,169,532 | (906,468) | - |
| | | | 340 | 1,299,480 | (776,520) | - |
| | | | 374 | 1,429,428 | (646,572) | - |
| | | | 391 | 1,494,402 | (581,598) | - |

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# 7.0 BIBLIOGRAPHY

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